

# Scotch-Tape Mirror for Hard X-rays Project

Completed Technology Project (2011 - 2012)



## Project Introduction

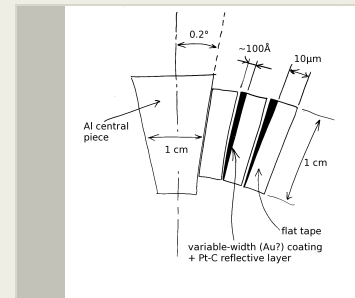
The Scotch-Tape Mirror for Hard X-rays project is to test the possibility of building a grazing incidence mirror for hard X-rays ( $E > 20$  keV) using a "scotch-tape" design, in which a thin plastic tape with a specific thickness profile and a multilayer reflective coating is tightly wound into a roll. The goal is to find a low-cost way of building a telescope for hard X-rays with a very large effective area.

The project is to build a grazing incidence mirror for hard X-rays ( $E > 20$  keV) using a "scotch-tape" design, in which a thin plastic tape with a specific thickness profile and a multilayer reflective coating is tightly wound into a roll. Key challenges are (a) to find a suitably smooth tape substrate (this has been done), (b) to wind a large number of tape shells onto the smooth metal centerpiece without introducing and accumulating shape irregularities, and (c) to give the tape the variable thickness profile in order to achieve the desired optical figure. Our immediate goal is to demonstrate the idea feasibility by building a crude conical X-ray concentrator. If successful, we will aim at building and flying a mirror prototype on a balloon and then proposing for an Explorer mission or MOO. The ultimate goal is a telescope with  $1 \text{ m}^2$  effective area at  $E = 30$  keV.

## Anticipated Benefits

Anything substantially bigger than the currently flying NuSTAR and the planned Astro-H high-energy X-ray telescope is likely to be cost-prohibitive if using the current technology. Our method may thus make it possible to launch larger telescopes within acceptable cost.

Any industry that uses X-ray imaging at photon energies above 20-30 keV may benefit from this cheaper mirror design.



Scotch-Tape Mirror for Hard X-rays

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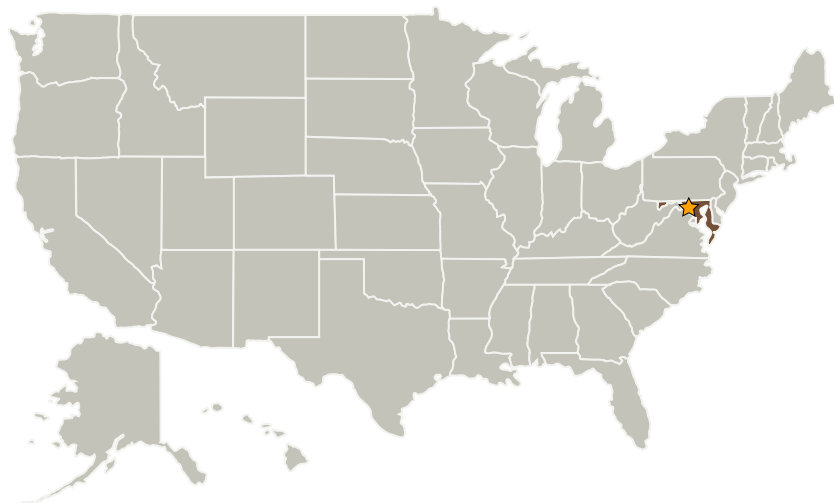
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### Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Goddard Space Flight Center (GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

### Primary U.S. Work Locations

Maryland

### Organizational Responsibility

**Responsible Mission Directorate:**

Mission Support Directorate (MSD)

**Lead Center / Facility:**

Goddard Space Flight Center (GSFC)

**Responsible Program:**

Center Independent Research & Development: GSFC IRAD

### Project Management

**Program Manager:**

Peter M Hughes

**Project Manager:**

Stanley D Hunter

**Principal Investigator:**

Maxim L Markevitch

**Co-Investigators:**

Takashi Okajima

William W Zhang

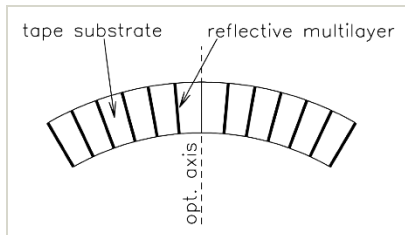
Peter J Serlemitsos

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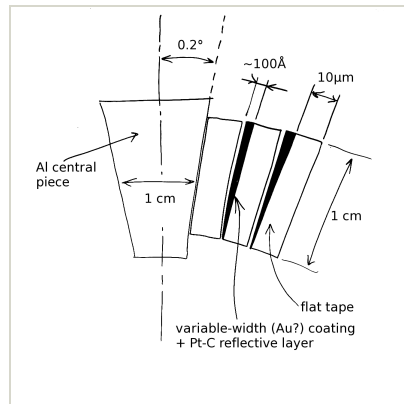


### Images



#### Scotch-Tape Mirror for Hard X-rays

Scotch-Tape Mirror for Hard X-rays  
(<https://techport.nasa.gov/image/3024>)



#### Scotch-Tape Mirror for Hard X-rays

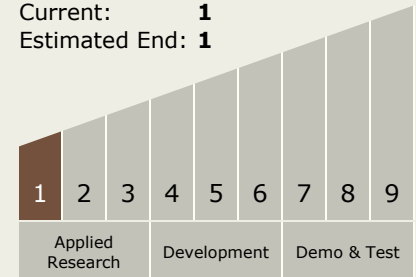
Scotch-Tape Mirror for Hard X-rays  
(<https://techport.nasa.gov/image/3023>)

### Project Website:

<http://sciences.gsfc.nasa.gov/sed/>

### Technology Maturity (TRL)

Start: **1**  
Current: **1**  
Estimated End: **1**



### Technology Areas

#### Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.1 Mirror Systems